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FLOOD INSURANCE STUDY

TOWN OF WELLS, VERMONT
RUTLAND COUNTY

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JUNE 15, 1988

COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 500271

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWN OF WELLS, RUTLAND COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Wells, Rutland County, Vermont, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic anaylses for this study were performed by the U. S. Army Corps of Engineers (COE), New York District, during the preparation of a Flood Plain Technical Services report for the Town of Wells. The work for that study was completed in April 1986. The hydraulic analyses for this study were performed by DuBois & King, Inc., for the COE during preparation of the Flood Plain Technical Services for the Town of Wells.

1.3 Coordination

On December 15, 1986, the Town of Wells was notified by the Federal Emergency Management Agency (FEMA) of the initiation of a Flood Insurance Study for the community.

On June 10, 1987, a final Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA and the town to review the results of the study.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Wells, Rutland County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: Wells Brook, from the downstream corporate limits to approximately 1,450 feet downstream of Township Route 32; and Mill Brook, from its confluence with Wells Brook to Little Lake Dam. Little Lake, Lake St. Catherine, and Lake Lucidian were studied by detailed methods for their entire shorelines within the community. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Bullfrog Hollow, the remaining portions of Wells Brook , and several unnamed tributaries were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

2.2 Community Description

The Town of Wells, with a total area of 14,476 acres, is located in southwestern Rutland County in southwestern Vermont. It is bordered by the Town of Poultney to the north; the Town of Middletown Springs to the northeast; the Town of Tinmouth to the east; the Town of Pawlet to the south; and the Town of Granville, New York, to the west. In 1985, it had a population of 815 (Reference 1).

Mill Brook is a tributary of Wells Brook, which flows into the Mettawee River.

Lake St. Catherine, near th origin of the Mill Brook drainage basin, flows into Little Lake, and these two lakes form a large portion of the Mill Brook basin.

2.3 Principal Flood Problems

Flood problems along Wells Brook and Mill Brook are generally associated with spring runoff and summer thunderstorms. Some ice jamming has been known to occur in the past, although it was not considered within the confines of this study. Flood problems for Little Lake, Lake St. Catherine, and Lake Lucidian are generally associated with snowmelt and spring rains and severe summer storms.

2.4 Flood Protection Measures

Flood control structures in the area include Little Lake Dam and an old stone dam near the Goodrich Road bridge over Mill Brook, neither of which provides protection from flooding.

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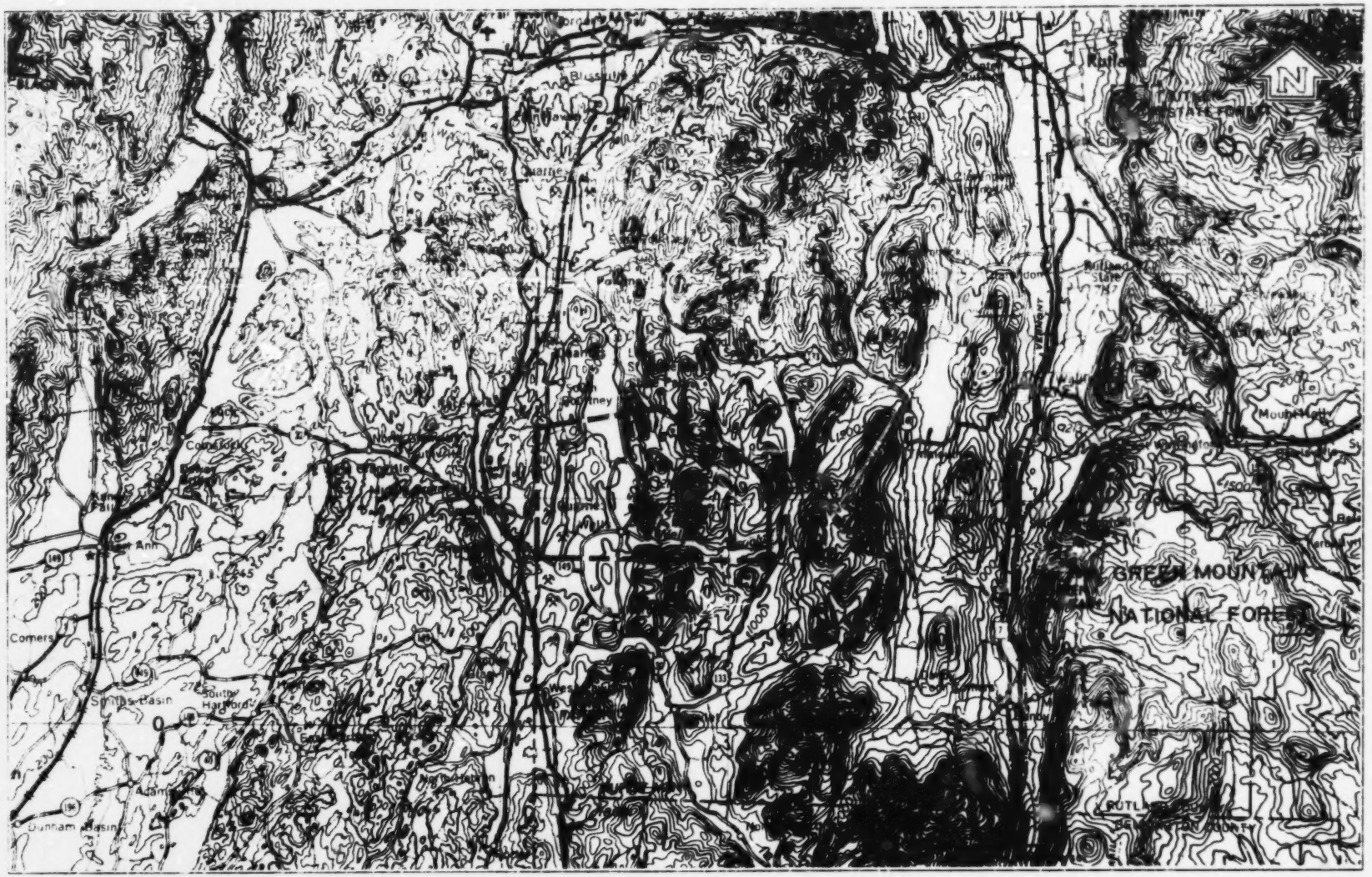

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WELLS, VT

(RUTLAND CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

For Wells Brook, Mill Brook, Little Lake, and Lake St. Catherine, a HEC-1 model was developed for the watershed above the community (Reference 2). The HEC-1 model was composed of 4 sub-areas with a total drainage area of 25.25 square miles. Within the HEC-1 model, a reservoir flood routing was performed at Little Lake Dam utilizing a known storage versus discharge relation. A unit hydrograph was developed for the watershed of Lake Lucidian through computer modeling. It has a drainage area of 0.73 square miles (Reference 3).

The Technical Paper No. 40 storm precipitation data was applied to the HEC-1 model for the 10-, 50-, 100-, and 500-year floods (Reference 4). For these runs, an initial rate of 1 inch per hour and constant rate of 0.1 inch per hour were used.

A summary of the drainage area-peak discharge relationships for the Wells Brook and Mill Brook studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WELLS BROOK					
Below confluence of Mill Brook	25.3	2,863	4,195	4,733	6,111
Above confluence of Mill Brook	16.1	2,470	3,630	4,090	5,280
Below confluence of Snow Brook	14.3	1,980	2,900	3,280	4,210
Above confluence of Snow Brook	12.9	1,830	2,690	3,040	3,900
Below Moosehorn Mountain	11.7	1,700	2,500	2,820	3,630
Above Moosehorn Mountain	9.6	1,470	2,150	2,430	3,130
MILL BROOK					
At confluence with Wells Brook	9.2	460	760	900	1,310
At Little Lake Dam	7.8	390	640	760	1,130

Reservoir flood routing was performed at Little Lake Dam utilizing a known storage versus discharge relation. A unit hydrograph was developed for the watershed of Lake Lucidian through computer modeling. It has a drainage area of 0.73 square miles (Reference 3).

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for Little Lake, Lake St. Catherine, and Lake Lucidian and are summarized in Table 2, "Summary of Stillwater Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LITTLE LAKE				
Entire shoreline within community	485.7	486.2	486.4	486.9
LAKE ST. CATHERINE				
Entire shoreline within community	485.7	486.2	486.4	486.9
LAKE LUCIDIAN				
Entire shoreline within community	498.4	498.6	499.0	499.5

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3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross section information and bridge structural geometry were obtained through field measurements.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 5). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for Wells Brook were determined using the slope/area method. In those areas where analysis indicated supercritical flow conditions, critical depth was assumed for the flood elevation because of the inherent instability of supercritical flow. Starting water-surface elevations for Mill Brook were taken from elevations on Wells Brook at the confluence of Mill Brook.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the FIRM (Exhibit 2); the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as

the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the flooding sources studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 6).

Approximate flood boundaries were delineated using the Flood Hazard Boundary Map for the Town of Wells (Reference 7).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

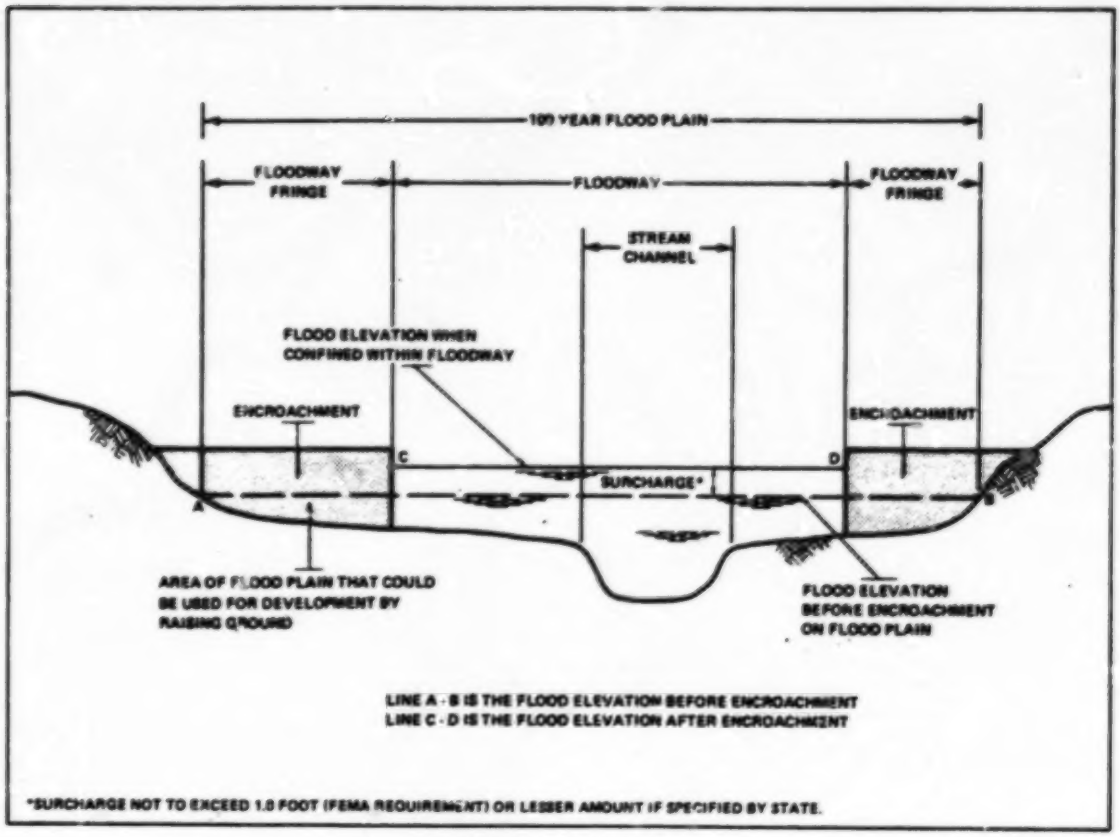
4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are

tabulated for selected cross sections (Table 3). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Wells Brook								
A	5,100	241	1,137	4.2	439.3	439.3	439.8	0.5
B	5,600	437	1,889	2.2	440.3	440.3	441.3	1.0
C	6,000	76	828	4.9	449.3	449.3	449.4	0.1
D	8,100	152	501	8.2	457.5	457.1	457.7	0.6
E	9,100	67	505	8.1	466.7	466.7	467.7	1.0
F	10,800	151	555	5.9	479.1	478.9	479.4	0.5
G	11,170	53	259	12.6	482.5	482.4	483.0	0.6
H	12,170	154	453	7.2	500.3	500.1	500.2	0.1
I	12,820	690	1,291	2.5	507.2	507.2	507.3	0.1
J	14,620	74	291	11.3	526.8	526.4	526.4	0.0
K	17,120	70	337	9.7	572.7	572.7	572.7	0.0
L	19,620	51	257	11.8	617.8	616.7	617.0	0.3
M	20,420	72	310	9.8	637.1	637.1	637.1	0.0
N	20,770	69	290	10.5	643.7	643.7	644.0	0.3
O	20,970	53	246	12.4	654.2	654.2	654.5	0.3
P	21,460	116	607	5.0	669.0	669.0	669.0	0.0
Q	23,460	87	283	13.6	714.5	714.5	714.5	0.0
R	25,360	82	326	8.6	754.4	754.4	754.4	0.0
S	27,060	91	317	8.9	783.6	783.6	783.7	0.1
T	27,480	47	615	4.6	800.3	800.3	800.3	0.0
U	28,580	188	326	7.5	804.9	804.9	805.4	0.5

[1]Feet above confluence with Mettawee River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WELLS, VT
(RUTLAND CO.)

FLOODWAY DATA

WELLS BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Brook								
A	1,200	40	147	6.1	443.1	443.1	444.1	1.0
B	1,360	20	109	8.2	445.6	445.6	445.7	0.1
C	1,480	78	349	2.6	447.8	447.8	447.9	0.1
D	2,690	70	174	5.1	456.7	456.7	457.6	0.9
E	3,690	42	170	5.3	465.0	465.0	465.3	0.3
F	7,190	110	311	2.9	483.0	483.0	483.8	0.8

[1]Feet above confluence with Wells Brook

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WELLS, VT
(RUTLAND CO.)

FLOODWAY DATA

MILL BROOK

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Towns of Pawlet and Poultney (References 8 and 9). The Flood Insurance Study for the Town of Pawlet is in complete agreement with the results of this study. The Flood Insurance Study for the Town of Poultney does not agree with the results of this study due to flood boundary discrepancies on Lake St. Catherine between the two communities. Flood boundaries were not printed in the Poultney study since it is an area with minimal flood hazards.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

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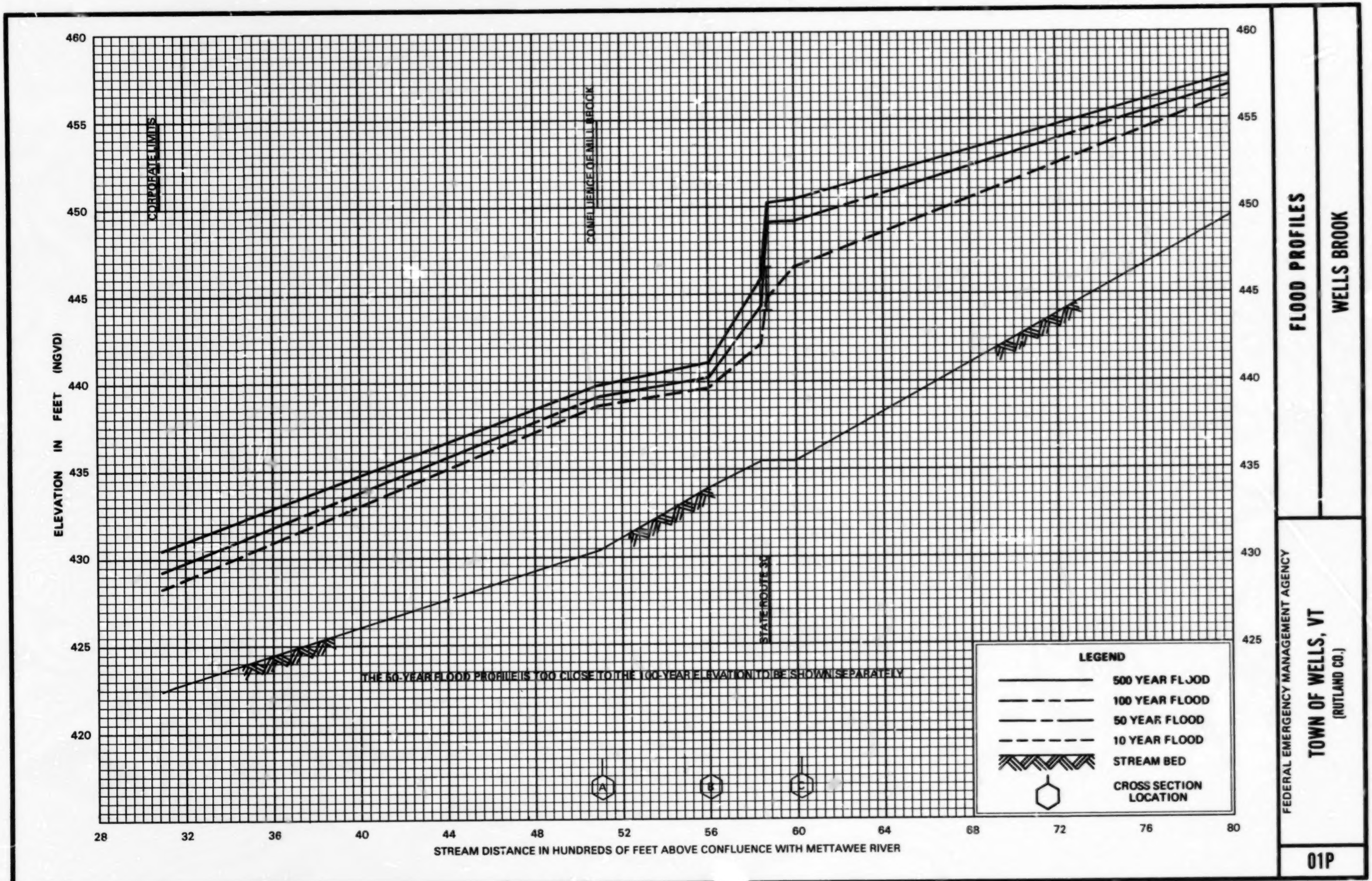
EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	04	485.06	Chiseled cross 0.3 mile north on State Route 2 (North Street) from State Route 30, at outlet of Little Lake, on east end of most northern 72-inch wide metal culvert under road.
RM 2	04	448.67	Chiseled square 0.15 mile northwest along Goodrich Road, Township Route 8, from State Route 30 at bridge over Mill Brook, on northern concrete curb, 12 feet from west end.
RM 3	04	446.18	State of Vermont tablet 1.2 mile southwest on State Route 30 from Wells Village, at bridge over Wells Brook, on east end of south abutment.
RM 4	04	470.30	Spike in utility pole No. 31/28 0.6 mile west on State Route 30 from Wells Village, on south side of highway.
RM 5	04	505.68	Chiseled square 0.05 mile south on State Route 2 (South Street) from State Route 30, at bridge over Wells Brook, on east end of south abutment.
RM 6	04	541.23	6 inch marble post with standard USGS tablet stamped TT21 GDF 1942 541 0.4 mile east on State Route 1 (East Street) from State Route 30, 26 feet north and 9 feet east of junction with fence line, 3.5 feet south of fence corner.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 7	05	579.39	Chiseled square 0.8 mile east on State Route 1 (East Street) from State Route 30, 40 feet north of road, at an abandoned concrete box culvert on Snow Bridge, on south end of west abutment.
RM 8	05	664.47	Spike in root of long, 24-inch hickory tree, 1.2 miles east on State Route 1 (East Street) from Route 30, 300 feet west of farmhouse, 25 feet north of road.
RM 9	05	680.14	Chiseled square on buried circular concrete base for mailbox No. 270, 1.6 miles east on State Route 1 (East Street) from State Route 30, on south side of road, east of driveway.
RM 10	05	727.05	Chiseled square 2.0 miles east on State Route 1 (East Street) from State Route 30, at concrete box culvert under road, on northwest corner.
RM 11	05	760.99	Chiseled square 2.3 miles east on State Route 1 (East Street) from Route 30, at footbridge across Wells Brook, 15 feet south of road centerline, on east end of top riser of concrete steps to footbridge.



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FLOOD PROFILES

WELLS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WELLS, VT
(RUTLAND CO.)

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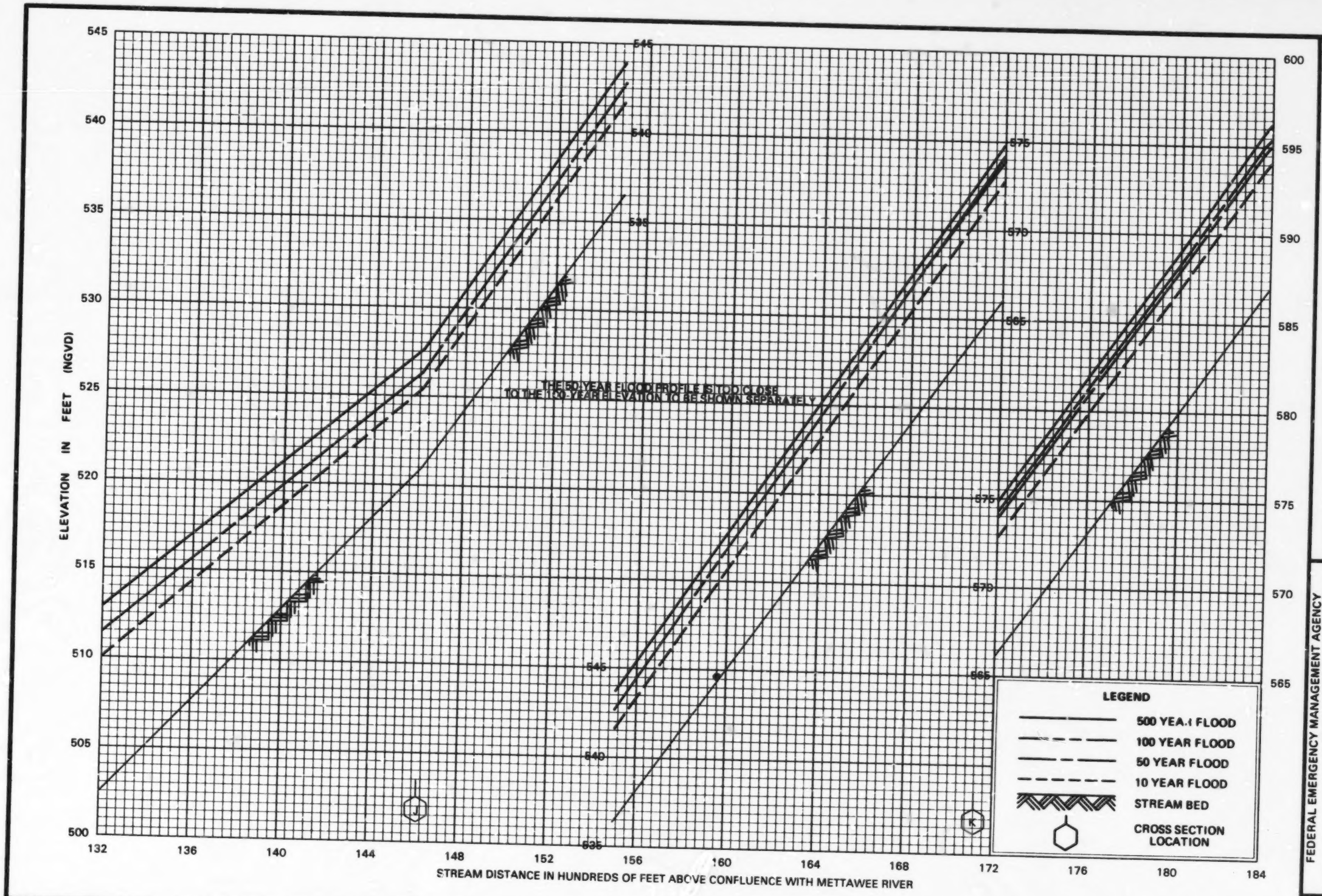

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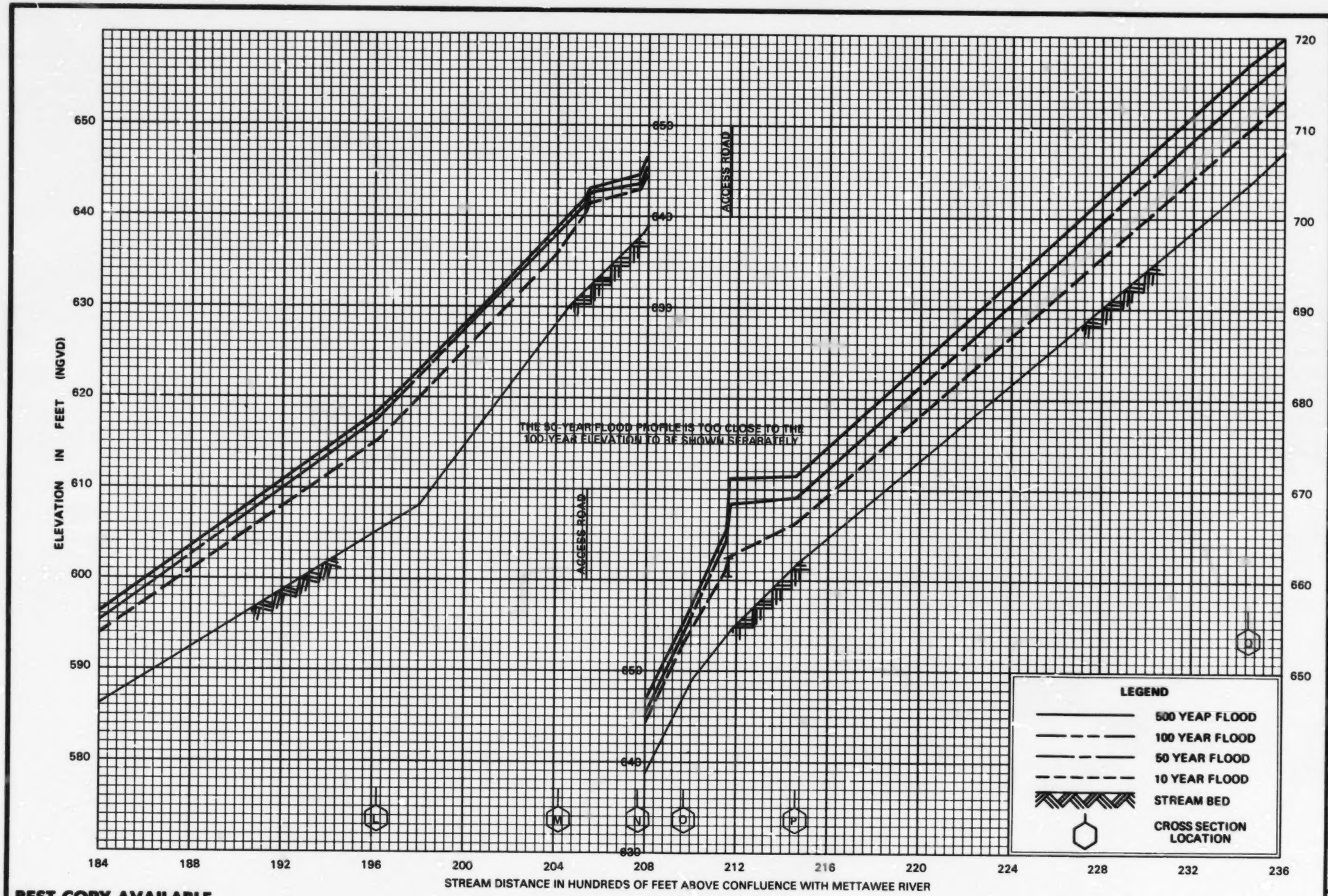

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04P

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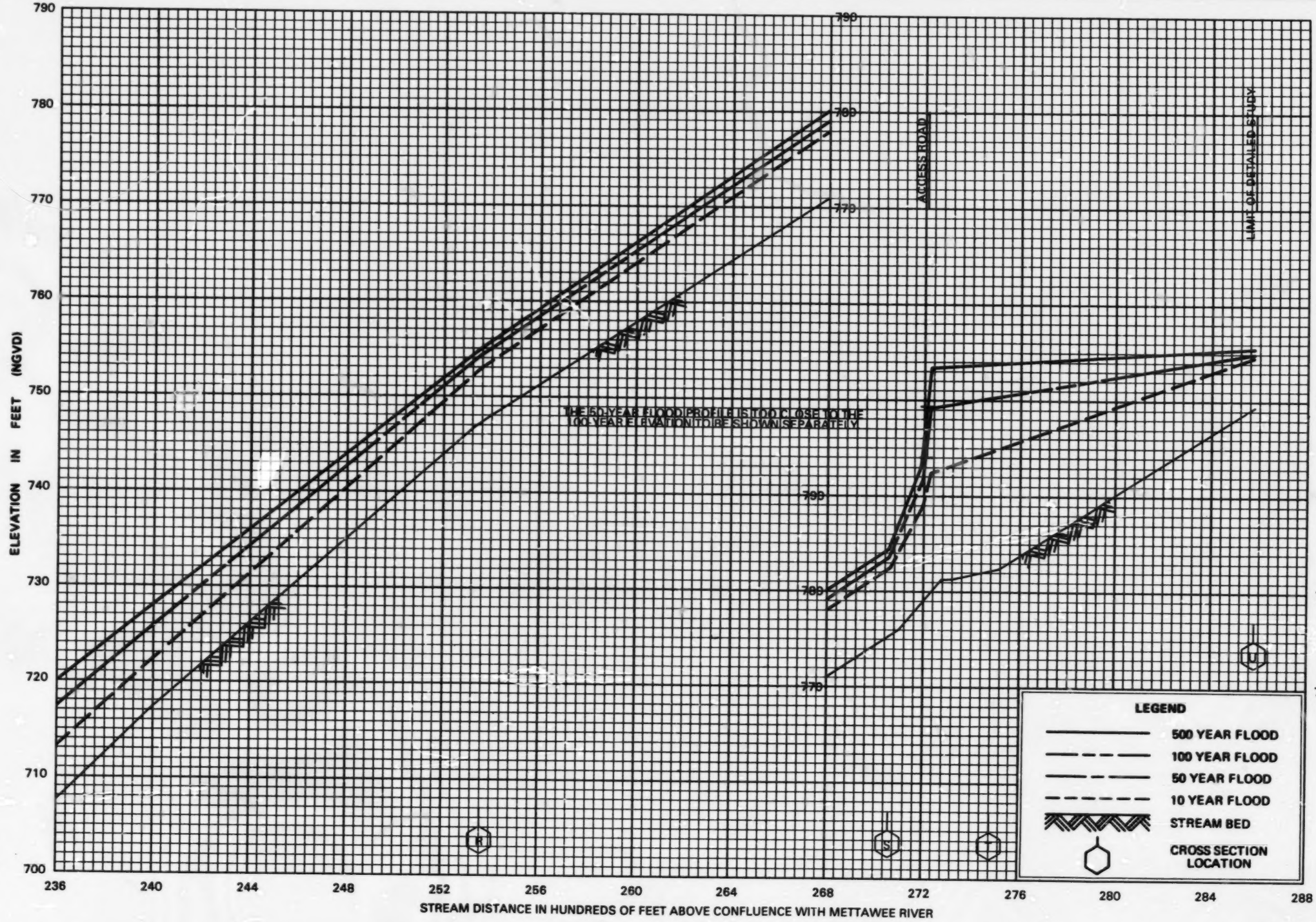

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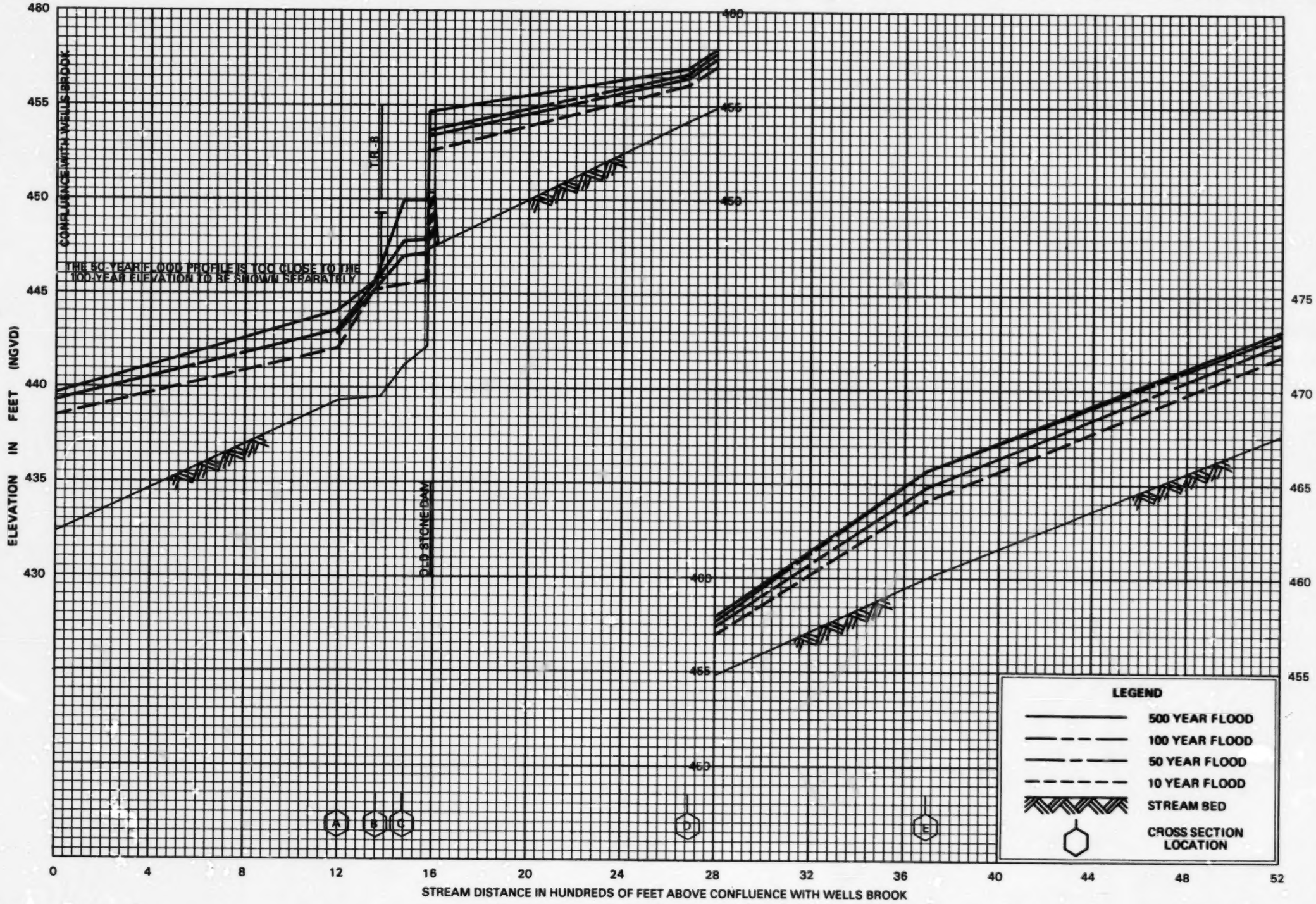

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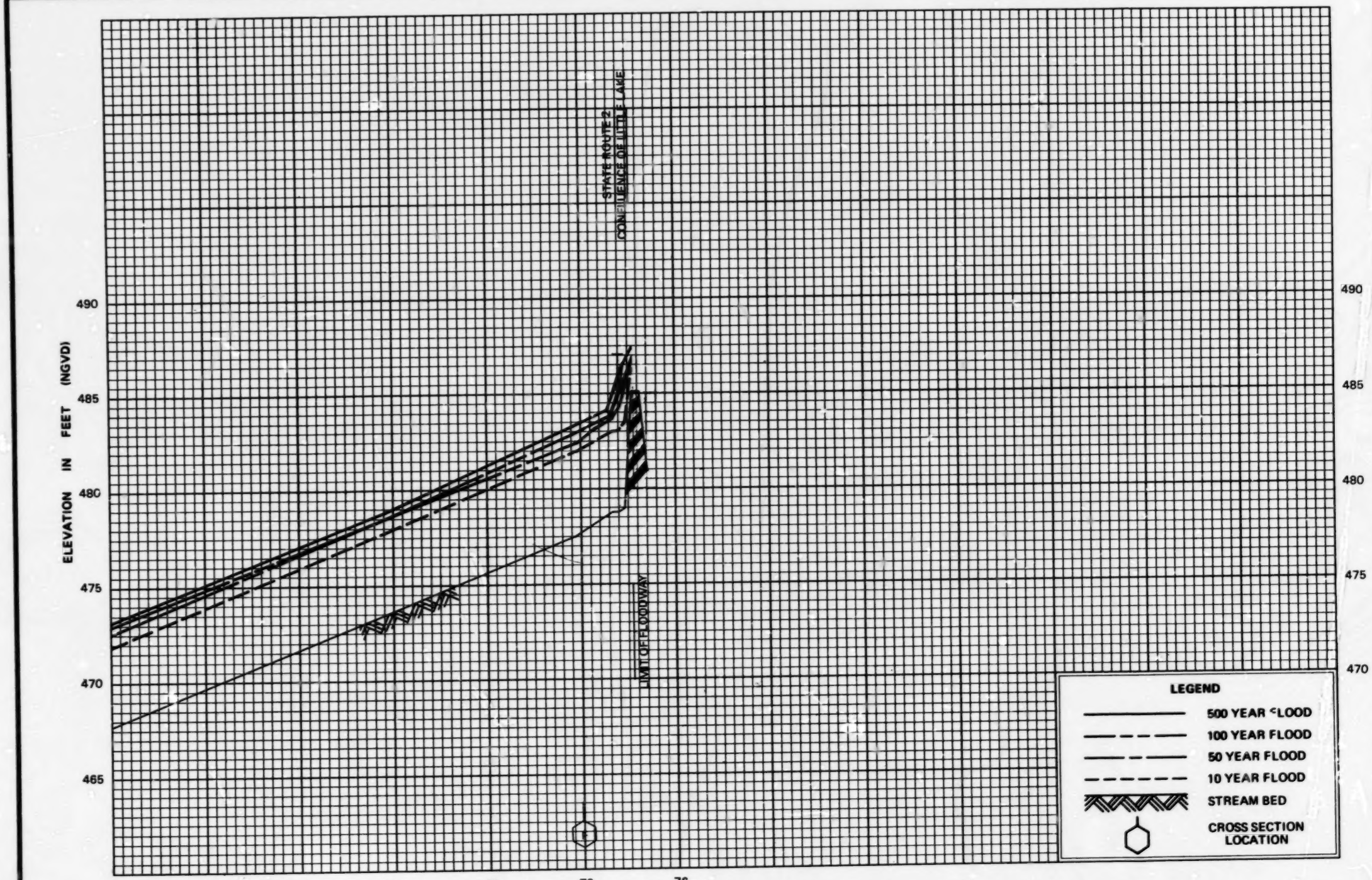

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